

STUDIES ON THE STABILITY OF IODINE COMPOUNDS IN IODIZED SALT *

F. C. KELLY, B.Sc., Ph.D., F.R.I.C.

Principal, Chilean Iodine Educational Bureau, London

Manuscript received in April 1953

SYNOPSIS

Contributions made by five groups of investigators to the knowledge of the stability of different iodine compounds in salt, and of the extent of the losses of iodine which may occur when iodized salt is exposed to different conditions of storage and use, are discussed by the author.

Stability of the iodine component in iodized salt is determined by : (1) moisture content of the salt and humidity of the atmosphere; (2) light, heat, and other meteorological factors; (3) impurities in the salt; (4) acidity or alkalinity of the mixture; and (5) the form in which iodine is present.

When potassium iodide or sodium iodide is used as the iodizing agent, the iodide content of the salt will remain constant and its distribution will remain uniform for many months if the salt is packed dry in a container with an impervious lining and kept dry, preferably in a cool place and away from strong light. When these conditions cannot be met, it is desirable to iodize salt with potassium iodate. Under adverse conditions of moisture, heat, and sunlight, the iodine content of salt iodized with potassium iodate remains relatively constant.

The stability of iodine compounds in salt is important for two reasons. First, it is necessary to ensure that iodized salt carries the actual amount of iodine stipulated by medical authority; individuals and peoples for whom iodized salt is intended as a goitre preventive must receive the effective quantity in their daily intake of salt, and not something less. Secondly, regulations governing the sale of iodized salt must be framed in fairness to manufacturers under statutory obligation to provide iodized salt of a certain standard. The prescribed level must lie within permitted upper and lower limits to allow a margin of error in manufacture.

Only five groups of investigators have made any serious contribution to the knowledge of the stability of different iodine compounds in salt,

* This article will also be published, in Spanish, in the *Boletín de la Oficina Sanitaria Panamericana*.

and of the extent of the losses of iodine which may occur when iodized salt is exposed to different conditions of storage and use. They are :

(1) Th. von Fellenberg, Federal Public Health Laboratory, Berne, Switzerland, who published his findings in the years 1923 to 1926; ^{7, 8}

(2) Johnson & Herrington, Montana Agricultural Experiment Station, USA, who published in 1927; ⁹

(3) Cowie & Engelfried, University of Michigan, USA, who reported on the matter in 1939 and 1940 at the instance of the Iodized Salt Committee of the Michigan State Medical Society; ^{3, 4}

(4) Andrew & Stace, New Zealand Department of Scientific and Industrial Research, who published in 1938 and again in 1945; ^{1, 2}

(5) Davidson & Watson, Department of Agriculture, Ottawa, Canada, whose work is of comparatively recent date : 1948 and 1951. ^{5, 6}

Two of these groups—Johnson & Herrington of Montana, and Davidson & Watson of Ottawa—were concerned specially with agricultural salt for animal feeding. The others dealt solely with iodized salt for human consumption. In addition to these major studies, some unpublished results of storage tests recently carried out (1952) by Professor Margaret M. Murray, Bedford College, London, by the Salt Division of Imperial Chemical Industries Limited, and by the Chilean Iodine Educational Bureau, London, are available.

All kinds of treatments have been applied to iodized salt to find out whether, and to what extent, the iodine content can be influenced : storage in metal and cardboard cartons, lined and unlined; storage with and without the addition of alkali and acid salts; storage in bulk in cotton bags, sacks, barrels, vats, and tower silos; storage under sheltered and semi-sheltered conditions in jars, and on shelves in sheds, barns, lofts, and laboratories; subjection to sun and wind outdoors, to leaching by rain, and to different humidities indoors; exposure to ultra-violet light, infra-red rays, electric light, and heat; centrifugation; and even to agitation by driving boxes of iodized salt over 1,000 miles (1,600 km) of rough roads in a motor-car.

Addition levels in these experiments have ranged from one part of iodine in 600 parts of salt to one part in 250,000 parts of salt; the iodine compounds tested have been potassium iodide, potassium iodate, dithymol di-iodide, and an organic iodide complex containing 40% of iodine. The effect of chemical stabilizers such as thiosulfate and calcium stearate has also been studied.

Five principal groups of physical or environmental factors determine whether or not iodine will be lost from iodized salt. These are :

(1) moisture content of the salt and humidity of the atmosphere ;

(2) light, heat, excessive currents of air, and weather conditions generally;

(3) impurities in the mother-liquor crystallized out with the sodium chloride of the salt;

(4) reaction : factors pertaining to acidity or alkalinity of the salt;

(5) the form in which the iodine is added (i.e., iodide, iodate, or other compound).

In itself, the time factor, that is, ageing or the length of time during which a salt may be stored without losing iodine, does not seem to matter, provided the other five conditions—or a majority of them—are satisfied in one way or another. These various factors are considered one by one below. As the supporting analytical data are too extensive to reproduce as a whole, a few representative figures have been selected to illustrate particular points.

Moisture

All investigators are agreed that when the moisture content of a salt is high—to the extent of being damp to the touch—losses of iodine are liable to occur if the iodizing agent is potassium iodide. Fellenberg^{7,8} first noticed this. He worked mainly with a rather coarse cooking-salt not specially dried, and found that the iodide, evenly dispersed at first, underwent redistribution throughout the mass on storage. By reason of its weight, some of the moisture, which is, in fact, a residue of the mother-liquor from which the salt is crystallized, gradually sinks, carrying dissolved iodide with it, and causes a concentration at the bottom of the mass. Simultaneously, drying takes place at the top of the mass, and some of the mother-liquor with iodide in it is drawn to the surface by capillary action. The middle layers of salt are therefore reduced in iodide content. With the upward migration of iodide and the drying of the salt at the top, a small amount of free iodine may be liberated to the atmosphere. The conditions which determine this are explained later under the heading “Impurities” (see page 224).

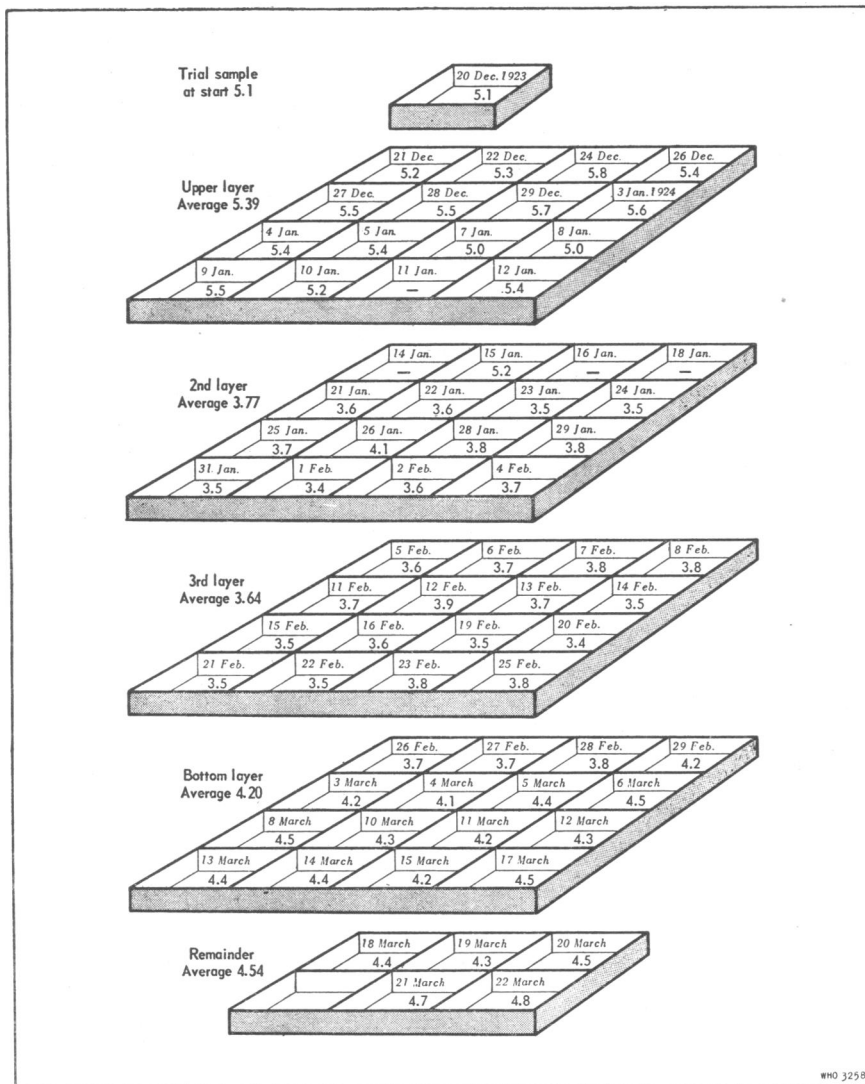
Fig. 1 clearly shows the kind of results Fellenberg obtained. It represents a vat of iodized salt from which he drew and analysed a succession of 5-kg samples layer by layer each day, except Sundays and holidays, over a period of three months. The whole mass comprised four main layers each having sixteen 5-kg plots; and it is evident that, on storage, the top and bottom layers became richer in iodine than did the two middle layers.

Fellenberg sums up his investigations by saying that potassium iodide in salt not specially dried always undergoes redistribution and may lose some of its iodine content to the atmosphere before the salt reaches the consumer. This can be obviated, he says, by choosing for iodization salt with as low a moisture content as possible and by putting the salt through a drying process immediately after iodization.

Fellenberg's finding that iodide in salt migrates from one part of the mass to another, if the salt is not quite dry, has been confirmed by others.

Table I contains part of a large number of analytical data published by Cowie & Engelfried^{3,4} showing that moisture moving from the inside to

FIG. 1. RESULTS OF DAILY ANALYSIS OF IODINE CONTENT IN A 400-KG VAT OF COMMON SALT FROM RHEIN SALT MINES *



* Analysis was carried out layer by layer—5-kg samples at a time—over a period of three months.
 Average iodine content of the 400 kg of salt at beginning of experiment = 5.10 mg/kg
 Average iodine content of 66 samples taken over 3 months = 4.29 mg/kg

Loss in 3 months = 0.81 mg/kg
 (16 %)

TABLE I. MIGRATION OF IODIDE TO CARTON *

Amount of iodine claimed (mg)	Amount found in salt (mg)	Amount found in carton (mg)	Total iodine found (mg)	Percentage of total in carton
240	166	51	217	23.5
160	347	21	368	5.7
160	243	24	267	9.0
160	160	19	179	10.6
160	146	28	174	16.0
160	139	64	203	31.5
160	124	36	160	22.5
160	90	70	160	43.7
160	90	17	107	16.0
160	88	26	114	22.8
160	83	17	100	17.0
160	76	87	163	53.3
160	76	42	118	35.6
160	63	54	117	46.1

* Milligrams of iodine claimed per packet, and milligrams of iodine actually found in salt and carton of packages of iodized salt representative of various Michigan localities are compared.

the outside of a salt mass carries with it a considerable amount of iodide which is taken up by the carton or other absorbent material in which the salt is packed.

TABLE II. IODIDE ABSORBED BY FABRIC OF BAG *

Bag No.	1	2	3	4
Top	0.19	0.20	0.30	0.92
Middle	0.40	0.34	0.60	1.04
Middle	0.56	0.38	0.64	1.16
Bottom	0.44	0.26	0.34	0.90

* Distribution of iodide between the top, middle, and bottom portions of the fabric of four bags is shown. Iodide is expressed as parts per 20,000 parts of salt.

Determinations by Andrew & Stace² of the iodide content of the top, middle, and bottom portions of the fabric of four bags in which iodized salt had been stored are given in table II. It will be seen that in these instances iodide migrated most strongly into the middle portion of the fabric of the

bag, probably because that part had a higher moisture content than the ends. As a rule, iodine losses from packed samples of moist salt are greatest from the bottom of the container because the salt in this part of the carton or bag is in contact with the largest proportional area of absorbing surface.

Andrew ¹ concludes from his investigations that the loss of iodide from iodized salt under ordinary conditions is entirely due to absorption of iodide by the cardboard or fabric of the container. He supports this conclusion by experiments showing that samples of iodized salt stored for six months in sealed and also in loosely-covered wide-mouthed glass jars exhibited no loss and no uneven distribution of the iodide. Similarly, salt spread very thinly over the bottom of a flat porcelain basin—thus exposing it to a large surface—and left open to room atmosphere for six months lost no iodine. On the other hand, salt thinly spread in another basin, but on the top of filter-paper, lost iodine considerably. On analysis, the filter-paper yielded sufficient iodide to account fully for the loss.

TABLE III. IODIDE MIGRATION STOPPED BY IMPERVIOUS LINING *

Carton number	Total amount of iodine in pasteboard (mg)	
	inner layer next to salt	outer layer
29	5	nil
39	5	nil
45	19	nil
17	23	nil
18	27	nil
46	36	nil
36	42	nil
31	64	nil
40	70	nil
32	86	nil

* Total iodine (in mg) in cartons made up of two layers of pasteboard separated by black adhesive plastic lining

Lacquered tins or containers with impervious linings are more suitable for iodized salt than unprotected cardboard cartons. Cowie & Engelfried ⁴ determined the iodine content of the inner and outer layers of ten iodized-salt cartons made with a black adhesive plastic lining between two layers of pasteboard. The results, given in table III, show that the lining effectively prevented the passage of iodide from the inner to the outer layer. The inner layer contained all the iodine found in the pasteboard carton.

Light, Heat, and Excessive Air Currents

On exposure to sunlight, salt iodized with potassium iodide loses a considerable amount of iodine. If, however, the salt is iodized with potassium iodate there are no losses. Johnson & Herrington⁹ have clearly demonstrated this (see table IV). Four salts—three iodized with potassium

TABLE IV. EFFECT OF SUNLIGHT ON LOSS OF IODINE FROM SALT

Storage period	Iodine content (%)			
	salt 1 (iodate) ^a	salt 2 (iodide) ^b	salt 3 (iodide) ^c	salt 4 (iodide) ^d
Original	0.0482	0.0474	0.0404	—
10 weeks	0.0480	0.0378	0.0206	0.0596
17 "	0.0474	0.0305	0.0137	0.0569
27 "	0.0468	0.0271	0.0132	0.0557
40 "	0.0479	0.0228	0.0055	0.0530
48 "	0.0482	0.0214	0.0050	0.0507
57 "	0.0484	0.0191	0.0037	0.0475
63 "	0.0486	0.0126	0.0030	0.0449
Loss	nil	73 %	90 %	24 %

^a Salt iodized with powdered potassium iodate

^b Salt iodized with potassium iodide solution

^c Salt iodized with potassium iodide, and recrystallized

^d Salt iodized with potassium iodide, and recrystallized

iodide and one with iodate—were exposed to sunlight on the sill of a south window in open crystallizing dishes. The iodide salts lost, respectively, 73%, 90%, and 24% of their iodine during a storage period of 63 weeks. The iodate salt retained its entire iodine content throughout the same period. These authors have also shown that even when exposed to sunlight in covered containers, salt iodized with iodide may lose as much as 15% of its iodine in two days.

From the few experiments that have been carried out, it is evident that excessive heat has the same effect on an iodide-containing salt as sunlight; exposure to heat causes iodine loss. This is only true, however, if the salt is neutral or acid in reaction. A salt made slightly alkaline with sodium bicarbonate, or a salt iodized with iodate, loses no iodine on exposure to heat. Table V exemplifies this.

When iodized salt is stored in draughty places or is otherwise exposed to undue currents of air it is liable to deteriorate in iodine content. Over

TABLE V. EFFECT OF HEAT ON LOSS OF IODINE FROM SALT

Degree and duration of exposure	Iodine content (%)			
	salt A containing iodide (alkaline) ^a	salt B containing iodide (acid) ^b	salt C containing iodide (neutral) ^c	salt D containing iodate (neutral) ^d
Control	0.0434	0.0429	0.0435	0.0459
80° C for 70 hours	0.0415	0.0324	0.0302	0.0451
80° C for 77 hours	0.0425	0.0318	0.0301	0.0460

^a Salt iodized with KI ; made alkaline with 1 % of NaHCO₃

^b Salt iodized with KI ; made acid with 1 % of KH₂PO₄

^c Salt iodized with KI ; neutral

^d Salt iodized with KIO₃ ; neutral

the course of a year Johnson & Herrington ⁹ made periodical examinations of two samples of stock salt (iodized to contain approximately 0.0625 % of potassium iodide) which were stored freely exposed to air—one in an open jar placed in an open shed and the other in a coarse canvas bag placed in the loft of a barn. After about 13 months' storage, the salt in the canvas bag had lost 12.7 % of its iodine while that stored in the glass jar had lost only 5.6 %. This is considered to be due to the fact that air would circulate much more freely in the salt stored in the canvas bag (and would consequently remove free iodine more rapidly) than in that stored in the glass jar.

Impurities

We have seen that if a salt iodized with potassium iodide is not dry, the moisture it contains moves in various directions carrying dissolved iodide with it. Some sinks to the bottom by reason of its weight, and some is attracted to the surface by capillary action or is drawn into the absorbent container material at the sides.

If the salt mass is not excessively large and if the surrounding atmosphere is low in moisture, the upper layers of salt dry out after a time, and a relatively large proportion of the water content of the salt evaporates in a limited space, thus increasing the iodine concentration of the topmost layers.

Simultaneously with the upward migration of iodide and the drying of the salt at the top, a small amount of iodine is liberated to the atmosphere. The precise chemical reactions which determine this are not clear, but Fellenberg ⁸ ascribes the liberation to the presence of chemical impurities in the salt and gives the following explanation of what probably occurs.

Taking part in the upward capillary migration of the iodide-laden moisture of the salt are small quantities of other salts dissolved in the mother-

liquor as minor impurities. Along with iodide, these become concentrated in the topmost layers of the salt and are precipitated on the surface of the salt crystals. Hydrolysis then takes place and it may be that, for example, magnesium chloride decomposes into magnesium hydroxide and hydrochloric acid. The hydrochloric acid then partially reacts with the potassium iodide, and iodine escapes as hydrogen iodide or, after oxidation, as free iodine.

Reaction

Iodized salts with an alkaline reaction retain iodine better than those having a neutral or acid reaction. The following experiment by Johnson & Herrington⁹ demonstrates this.

Two samples of salt iodized to contain approximately 0.0625% of potassium iodide were selected; one was made acid by the addition of 1% of KH_2PO_4 and the other was made alkaline by the addition of 1% of NaHCO_3 . Both samples were stored under the same bell-jar and their iodine contents were determined periodically over a period of more than a year. The results, given in table VI, show that the salt rendered acid lost about one-

TABLE VI. STORAGE OF ACID AND ALKALINE IODIZED SALTS

Date	Storage period (weeks)	Iodine content (%)	
		salt containing KH_2PO_4	salt containing NaHCO_3
2.10.25	0	0.0466	0.0475
28.11.25	8	0.0475	0.0482
4. 2.26	18	0.0389	0.0482
7. 5.26	31	0.0358	0.0489
28. 6.26	38	0.0345	0.0493
3. 9.26	48	0.0327	0.0495
13.10.26	54	0.0313	0.0496
Loss		32.8 %	nil

third (32.8%) of its iodine during storage, whereas the salt rendered alkaline not only did not lose any iodine but actually gained slightly in iodine content. This is ascribed to the fact that the two salts were stored under the same bell-jar so that some of the iodine lost from the acidified salt was presumably absorbed by the alkaline salt. Another example of how the addition of alkali protects salt from loss of iodine is given by the figures in table V.

Iodine Compound Used

Brief reference has already been made to the observation that when salt is exposed to sunlight or heat no losses of iodine occur if the salt has been iodized with potassium iodate instead of the more usually employed potassium iodide (see tables IV and V).

Most rigorous of all tests on the stability of iodate in salt are those of Davidson, Finlayson & Watson ⁵ They studied the losses of iodine from pressed blocks of iodized salt used for animal feeding. These blocks were placed in the open and subjected to all weathers—wind, rain, and sun. Four forms of iodine were tested for stability, namely: potassium iodide, potassium iodate, dithymol di-iodide, and a specially prepared organic iodide complex. The iodide series comprised blocks made from six different mixes including those with and without protective agents (sodium thiosulfate and calcium stearate) and with and without the addition of ferric oxide. Iodine determinations at intervals gave the results set out in tables VII and

TABLE VII. STABILITY OF POTASSIUM IODIDE IN IODIZED BLOCK SALT EXPOSED TO ALL WEATHERS *

Duration of exposure	Mixture						
	1 <i>a</i>	2 <i>b</i>	3 <i>c</i>	4 <i>d</i>	5 <i>e</i>	6 <i>f</i>	7 <i>g</i>
	parts of iodine in 100,000 parts of salt						
Original	11	11	13	14	11	13	4
2 months	nil	nil	trace	nil	nil	nil	nil

* Pressed blocks made from seven different mixes were exposed to "pasture conditions" outdoors, namely, to weathering by wind, rain, and sun.

a NaCl + KI

b NaCl + KI + Fe₂O₃

c NaCl + KI + Na₂S₂O₃

d NaCl + KI + Na₂S₂O₃ + Fe₂O₃

e NaCl + KI + Ca stearate

f NaCl + KI + Ca stearate + Fe₂O₃

g NaCl alone

VIII. Blocks containing potassium iodate retained a high percentage of their original iodine content when subjected to severe outside exposure for two months. Those containing potassium iodide and organic iodide complex rapidly lost all iodine. Dithymol di-iodide occupied an intermediate position in regard to stability, but for other reasons cannot be seriously considered as an iodizing agent in salt intended for human consumption.

The foregoing points may be conveniently summarized thus :

SALT IODIZED WITH IODIDE

Losses of Iodine

are liable to occur
if the salt :

do not occur
if the salt :

Contains *moisture*. Is not specially dried during production

Is reasonably *dry* and *free-running*

Is exposed to *humid atmosphere* or excessive *aeration*

Is packed in containers with *impervious linings*

Is exposed to *sunlight*

Is stored in the *dark*

Is subjected to *heat*

Is kept *cool*

Has an *acid reaction*

Contains added *alkali* or other *stabilizer*

Contains *impurities* from original mother-liquor

Is *free from impurities*

TABLE VIII. STABILITY OF POTASSIUM IODATE, DITHYMOL DI-IODIDE, AND AN IODIDE COMPLEX IN BLOCK SALT EXPOSED TO ALL WEATHERS *

Duration of exposure	Mixture					
	1 <i>a</i>	2 <i>b</i>	3 <i>c</i>	4 <i>d</i>	5 <i>e</i>	6 <i>f</i>
	dithymol di-iodide		potassium iodate		iodide complex	
	parts of iodine per 100,000 parts of salt					
Original	24	20	18	19	14	14
10 days	18	13			4	nil
14 days			16	16		
20 days	17	11				
28 days			16	16		
30 days	10	8				
40 days	12	10				
7 weeks	12	10				
8 weeks			14	14		
9 weeks	11	11				

* Pressed blocks made from six different mixes were exposed to "pasture conditions" outdoors, namely, to weathering by wind, rain, and sun.

a Salt with 0.033 % of dithymol di-iodide

b Salt with 0.033 % of dithymol di-iodide and 0.1 % of iron oxide

c Salt with 0.0253 % of potassium iodate

d Salt with 0.0253 % of potassium iodate and 0.1 % of iron oxide

e Salt with 12.5 oz (354.5 g) of an organic iodide complex (with 40 % I) per ton

f Salt with 12.5 oz (354.5 g) of iodide complex per ton and 6.4 oz (181.5 g) of cobalt carbonate per ton

Salt iodized with potassium iodide, if dry, free-running, and properly packed in lined cartons, does not lose iodine or undergo redistribution of iodide under normal conditions of storage. The results of recent storage-tests with high-grade table salt of this kind are given in table IX, and show

TABLE IX. STORAGE TESTS ON REFINED FREE-RUNNING TABLE SALT *

	Iodine content		
	μg per ounce **	per cent by weight	proportion I/NaCl
Specification	425-652	0.0015-0.0023	1: 66,600-1: 43,500
Mean	538	0.0019	1: 52,600
Analysis by maker on issue (28.3.51)	538	0.0019	1: 52,600
A(1). Stored on open laboratory shelf above sink until 5.7.51			
After three months Top	567	0.0020	1: 50,000
(5.7.51) Middle	567	0.0020	1: 50,000
A(2). Remaining contents of packet A(1) opened on 5.7.51 were remixed and replaced on shelf with top of packet fully open until 19.2.52. Some caking at top of sample in February 1952.			
After ten months Top	567	0.0020	1: 50,000
(19.2.52) Middle	538	0.0019	1: 52,600
B. Stored in dry cupboard away from fumes until 19.2.52. No evidence of caking.			
After ten months Top	567	0.0020	1: 50,000
(19.2.52) Middle	567	0.0020	1: 50,000
Bottom	510	0.0018	1: 55,500
C. Stored on open laboratory shelf above sink until 19.2.52. No evidence of caking.			
After ten months Top	538	0.0019	1: 52,600
(19.2.52) Middle	538	0.0019	1: 52,600
Bottom	538	0.0019	1: 52,600

* Delivered for independent analysis in 7-lb (3.2-kg) lots in cotton bags. Repacked on 3.4.51 by analyst into 1-lb (0.45-kg) cardboard unlined packets supplied by makers. The packets were stored as shown above, and 25-g portions were subsequently taken from the top, middle, and bottom sections of the packets for analysis.

** One ounce = 28.3 grams.

that refined free-running table salt containing 1% of basic magnesium carbonate, and iodized with potassium iodide, suffers no loss on storage, if suitably packed.

On the other hand, where conditions in the right-hand column above cannot be fulfilled—as, for instance, in underdeveloped areas where salt

is very often of a crude native variety not subject to special drying and processing—iodization with potassium iodate is the recommended procedure.

Salt iodized with iodate is already in practical use in Mexico, and Dr. H. H. Stacpoole who is in charge of the goitre-prevention campaign there has reported favourably on its iodine-keeping qualities.^a The adoption of iodate has entirely overcome difficulties of iodine loss previously encountered when iodide was customarily added to the bulk supplies of crude unprocessed salt available for goitre prophylaxis in certain districts of Mexico.

RÉSUMÉ

La stabilité du composé iodé ajouté au sel est un facteur important de la prophylaxie antigoiitreuse par l'iode. Il faut, d'une part, que le consommateur reçoive effectivement la dose prescrite et que le fabricant, d'autre part, tenu de livrer un sel contenant une proportion donnée d'iode, soit assuré que le produit ne se détériorera pas rapidement. Or, depuis une trentaine d'années déjà, on s'est rendu compte que le sel traité par l'iodure de potassium perdait une partie de l'iode ajouté, si des précautions particulières n'étaient pas prises. L'effet de divers facteurs sur la teneur du sel en iode a été étudié : stockage dans des récipients de métal ou de carton, munis ou non de revêtements intérieurs protecteurs, des sacs en coton ou en papier; conservation sous abri total ou partiel, exposition aux intempéries, au soleil, aux vents, à l'humidité à l'intérieur des bâtiments, aux rayons infrarouges et ultraviolets, à la lumière électrique et à la chaleur, à la centrifugation, à l'agitation par transport, etc. On a constaté que la teneur en iode du sel traité par l'iodure de potassium, et non desséché, baisse assez rapidement. L'iode est entraîné en surface par capillarité à la suite de la dessiccation superficielle de la masse, et en profondeur avec les résidus d'eau-mère; il est absorbé par les parois poreuses des parois des récipients. Les couches intermédiaires et centrales des masses de sel se trouvent ainsi appauvries en iode. Des réactions chimiques à la surface des cristaux de sel, dues à la présence d'autres composés minéraux dans les eaux-mères (chlorure de magnésium, par exemple) peuvent contribuer à mettre l'iode en liberté. Le sel iodé alcalinisé par le bicarbonate de sodium ou le biphosphate de potassium retient mieux l'iode qu'un sel à réaction acide ou neutre. La comparaison entre l'ioduration et l'iodatation du sel est favorable à ce dernier procédé. Même après deux mois d'exposition aux intempéries, des blocs de sel iodaté avaient conservé un fort pourcentage d'iode, alors que le sel ioduré avait perdu rapidement tout l'iode ajouté. D'autres composés iodés, soumis aux essais, n'ont pas donné de résultats pratiquement utiles.

La dessiccation du sel, après ioduration, permet d'éviter les déperditions d'iode. Le sel ioduré, finement pulvérisé et conservé dans des récipients non absorbants ne perd pas d'iode dans des conditions normales de conservation. L'addition d'iodate est indiquée lorsque ces conditions ne peuvent être remplies, en particulier dans les pays où l'on utilise du sel brut qui ne peut être soumis à une dessiccation poussée. Au Mexique, par exemple, l'iodatation du sel a pallié les inconvénients que présentait l'ioduration.

^a See paper by Stacpoole on page 283.

REFERENCES

1. Andrew, R. L. (1938) *Analyst*, **63**, 179
 2. Andrew, R. L. & Stace, G. W. (1945) *Analyst*, **70**, 88
 3. Cowie, D. M. & Engelfried, J. J. (1939) *J. Mich. med. Soc.* **38**, 1057
 4. Cowie, D. M. & Engelfried, J. J. (1940) *J. Mich. med. Soc.* **39**, 784
 5. Davidson, W. M., Finlayson, M. M. & Watson, C. J. (1951) *Sci. Agric.* **31**, 148
 6. Davidson, W. M. & Watson, C. J. (1948) *Sci. Agric.* **28**, 1
 7. Fellenberg, Th. von (1923) *Biochem. Z.* **142**, 263
 8. Fellenberg, Th. von (1926) *Biochem. Z.* **174**, 364
 9. Johnson, A. H. & Herrington, B. L. (1927) *J. Agric. Res.* **35**, 167
-